149. *The Relative Sexuality in Synchytrium.*

By Shunsuke KUSANO.

Tokyo Imperial University.

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On studying the life-history of *Synchytrium fulgens* SCHRÖT. parasitic on *Oenothera* it has been ascertained that the zoospores, hitherto known as asexual reproductive cells, are in fact planogametes. The zygote formed by them develops into the resting cell, while their parthenogenetic development gives rise to gametangia.

The planogametes reveal no morphological difference from each other. Hence, the sexuality exhibited by the present fungus is isogamic. Yet, at the time of copulation one of the gametes becomes as a rule sedentary and spherical, while the other is active and pear-shaped. One or several gametes coming upon a sedentary one keep in close contact with and for a few minutes present a gliding movement on the latter. In the meantime copulation is effected between one of the active gametes and the sedentary one. On this account we can practically distinguish both sexes, female (sedentary) and male (active).

What is of special interest regarding the behaviour of the gamete is the following. While a male gamete (B) is engaging in fusion with a female (A), another male (C) comes in association, attempting also to fuse with A, but in the meantime copulation may take place between B and C. We can state that B is female towards C, though male towards A. Here no explanation is allowable other than that each gamete is not constant in the sex character, being female in relation to a certain gamete and male to another. It represents a case of the relative sexuality.

Some years ago HARTMANN,¹⁾ calling attention to a similar sexual process recorded in some isogamic organisms, postulated a hypothesis underlying the relative sexuality. He assumed that besides the typical female and male gametes there may occur intermediate forms, in which the female or male character is acquired in varying degrees (*multipolar sex differentiation*). Verification of this hypothesis was afterwards attempted by him²⁾ on *Ectocarpus siliculosus* and by JOLLOS³⁾ on

1) Hartmann, M.: Ueber sexuelle Differenzierung und relative Sexualität. *Studia Mendeliana*. 1923, p. 203; *Allgemeine Biologie II*. Jena, 1927.

2) Hartmann, M.: Untersuchungen über relative Sexualität. I. Versuche an *Ectocarpus siliculosus*. *Biol. Zentbl.* Bd. 45, 1925, S. 449.

3) Jollos, V.: Untersuchungen über die Sexualitätsverhältnisse von *Dasycladus clavaeformis*. *Biol. Zentbl.* Bd. 46, 1926, S. 279.

Dasycladus clavaeformis. Both authors ascertained in these algae the existence of strong and weak females as well as males and of the sexual affinity between a strong and a weak individual of the same sex. It follows that, while copulation is effected between either a strong(A) or a weak (B) female and any male (C), it may also be possible between A and B, then B behaving towards A as a male.

Thus, as regards the mutual relation between individual gametes, leading to the relative sexuality, our fungus and the algae mentioned above are in precise accordance. However, as to the mode of sex differentiation in the fungus extensive observations and experiments so far carried out bring forth a result admitting a fundamentally different interpretation.

The algae are recorded as dioecious, and each individual plant is believed to produce exclusively either female or male gametes acquiring the sex character in a definite degree. It shows, as a matter of fact, that the sex differentiation takes place in the mother plant, each giving strong or weak female gametes, otherwise strong or weak male ones. In the fungus the sister gametes derived from a single gametangium are able to form the zygote, showing haplomonocism, and, as a remarkable fact, they behave all as male gametes during their swimming stage and as female gametes after entering the sedentary stage. The sedentary gametes acquire a character to exert an attractive action upon the swimming ones which possess a property to react to it. It is by this means that both swimming and sedentary gametes are brought to a close contact with each other before fusion is effected between them, and that we can distinguish femaleness and maleness. However, it must be borne in mind that the sedentary state is not an indication of the gamete as being a female genetically. For, all gametes are disposed to attain sooner or later a resting stage preceding the infection of the host.

In *Ectocarpus siliculosus* copulation has been reported as taking place between the swimming and sedentary gametes. HARTMANN assumes the early sedentary gamete as a female and the lately sedentary one as a male individual. This is a point from which an interpretation on the mode of sex differentiation diverges in the algae and our fungus. In the latter organism the length of the swarm period indicates neither a definite sex of the gamete nor the degree of each sex character. In retaining the swimming activity the sister gametes present indeed a great variation (from a few minutes to more than 20 hours), but whenever the sedentary gametes appear, the active ones show the sexual action. To take the sedentary gamete as a female individual is

absurd, because the same individual has been behaving as a male gamete during its swimming stage. This fact gives an evidence for that each gamete is male at an early (swimming) and female at a later (sedentary) stage. Therefore, it may happen that to a sedentary gamete combines an active one, upon which the sedentary stage is approaching. In this case, the latter gamete, while attempting to fusion, turns into a female, becoming incapable of fusing with its partner, but being liable to be fused with any active one coming upon it. The result manifests what is called the relative sexuality. On this ground it may be concluded that the sex differentiation takes place, not in term of individual gamete, but in term of its life stage.

From this statement it follows naturally that the sexuality in *Synchytrium fulgens* is exhibited by the gametes showing no individual difference in the sex character. In this respect the gamete is comparable with some hermaphrodite organisms, in which each individual is first male and afterwards female,¹⁾ exhibiting consecutive monoecism. We look upon the relative sexuality as observed in the fungus a representation of consecutive monoecism in the gamete.

1) Goldschmidt, R.: The mechanism and physiology of sex determination. London, 1923.